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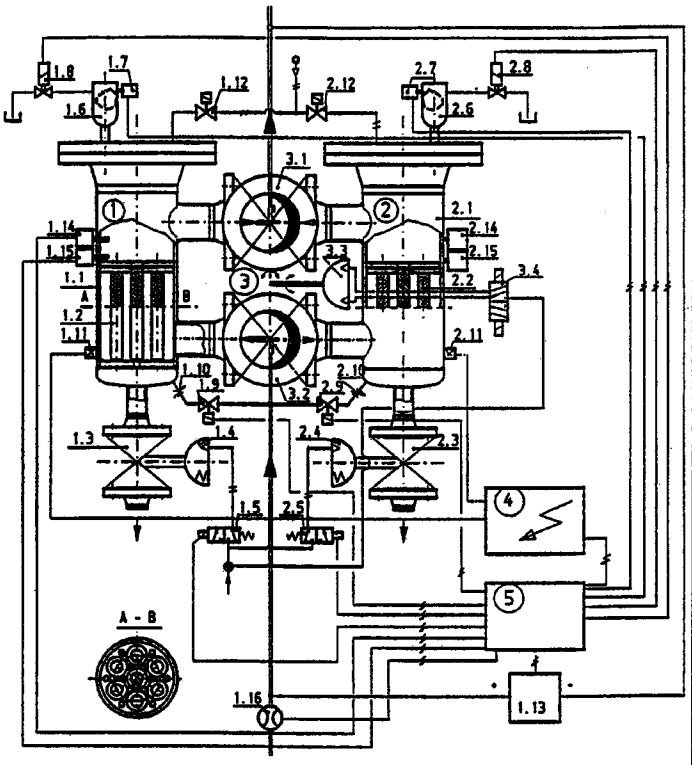
(57) Abstract

A procedure and means for filtering and homogenizing liquid substances and for automatic cleaning of the filters. In the procedure are utilized an ultrasonic generator (4) connected in conjunction with the filter unit (1; 2) and ultrasonic oscillators (1.11; 2.11) thereto connected, their power and frequency being controlled on the basis of the differential pressure present across the filter units (1; 2), the liquid pressure acting in the filter unit, the liquid flow rate, signals from liquid temperature pick-ups. In order to enhance the cleaning event of the filter elements (1.2; 2.2) taking place with ultrasonics, the filter unit (1; 2) is emptied during the cleaning phase, making use of compressed air conducted into the filter. In order to facilitate the liquid filtering event and to reduce the need of cleaning action with ultrasonics, during normal filtering an ultrasonic power is maintained which is sufficient for homogenizing the liquid. The filter unit (1; 2) furthermore contains one or several cylindrical filter elements (1.2; 2.2).



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PROCEDURE AND MEANS FOR FILTERING AND HOMOGENIZING LIQUID SUBSTANCES

The present invention concerns a procedure an a means for automatic filtering of liquid substances with a self-cleaning arrangement and possibly simultaneous homogenizing of the liquid that is being filtered.The procedure and means are based on using filter mesh elements, ultrasonics and compressed air.

In a liquid filtering event in which the liquid is passed through filter elements, the elements are soiled down and have to be replaced or cleaned. Since filter element replacing entails many detriments, e.g. the need to keep such elements in stock, the work involved in the replacement operation and possibly interruption of the filtering process, endeavours are generally aimed at performing doing the cleaning during operation if possible.

In the case of oils, for instance, cleaning during operation is usually implemented by conducting part of the flow which is being filtered back in reversed direction in an endeavour to achieve that the woven mesh, which is the type most often employed, will be flushed clean by the filtered liquid itself.

In the foregoing those natural drawbacks have already been described which arise from filter element replacing. The above-mentioned cleaning method during operation, based on reverse flow, also entails a number of drawbacks: the filters mesh fails to be completely cleaned in such a procedure. Secondly, the mesh may suffer damage from the pressure peaks induced by fuel supply pumps. Thirdly, when the liquid quantity required for reverse flushing is large, loss of time is incurred, and unnecessary twice-over purifying of the respective liquid quantity.

With the aid of the means of the invention quite significant improvement is achieved regarding the

drawbacks mentioned, among others. In order to implement this, the means of the invention is characterized by that which has been stated in the characteristic features part of Claim 1.

The most important advantages of the invention over other cleaning processes which take place during operation are to be seen in that by the procedure of the invention the filter elements will be more completely cleaned, the risk of damaging the filter mesh is prevented and reciprocating running of liquid is avoided.

The advantages gained as regards replacement of filter elements are obviously the same as those of cleaning during operation, which have already been discussed.

The invention is described in the following, referring in detail to the drawing attached, presenting an embodiment example of the invention. The invention is in no way narrowly confined to the details of said example.

As depicted in Fig. 1, the means comprises two identical filter units 1 and 2, these units being alternately one in use and the other in its cleaning cycle, or on conclusion of the cycle in readiness for use, and a switch-over valve assembly 3 with actuating mechanism, and an ultrasonic generator 4.

A filter unit is composed of a filter body 1.1, a filter element 1.2 which is exchangeable according to operating meed, a filtering residue removal valve 1.3, a single-action pneumatic actuator 1.4, a pilot valve 1.5, a float chamber 1.6 for air venting, a float-operated switch 1.7, a valve 1.8, a filling valve 1.9, a restriction 1.10, an ultrasonic oscillator 1.11, a compressed air flushing valve 1.12, a differential pressure switch or differential,pressure pick-up 1.13 and a control unit 5.

Equivalent components of filter unit 2 can be similarly identified as identical components, using

reference numerals 2.1 to 2.13, component 2.1 being the equivalent of component 1.1 in filter unit 1, and so on.

The switch-over valve assembly consists of a switch-over valve 3.1 for pure liquid, a switch-over valve 3.2 for impure liquid, a pneumatic actuating means 3.3 common to the foregoing components 3.1 and 3.2, and a pilot valve 3.4 for governing the component 3.3.

It is assumed in the example illustrating the operation of the means that filter unit 1 is operating, while unit 2 is standing by.

The degree of cleanness of the filter elements is monitored with a differential pressure switch, or pick-up, 1.13 installed across the incoming and outgoing pipelines, and to which may also be connected a differential pressure indicator means. When the differential pressure has reached a given, pre-set limit value, the valve 3.4 causes with the aid of the actuating means 3.3 the switch-over valves 3.1 and 3.2 to be positioned so that the liquid to be filtered will pass through the filter unit 2, which was in stand-by state heretofore.

During normal filtering, the ultrasonic head 1.11 (2.11) may be operated on low power in order to produce a slight cavitation phenomenon within the liquid to homogenize the liquid that is being filtered.

When the limit switch on the actuator of the switch-over valve actuator indicates that the liquid is passing through unit 2, unit 1 is switched to the cleaning cycle, the ultrasonic head 1.11 being now switched to receive power at a rate higher than the homogenizing power. The compressed air valve 1.12 opens and the pilot valve 1.5 causes the filtering residue elimination valve 1.3 to open, the size of which valve is selectable with a view to obtaining sufficient throttling, as a result of which the filter chamber will be drained within desired time. When the chamber is filled to capacity, and when it is being emptied, the internal cavitation caused in the liquid by the ultrasonics

causes efficient cleaning of the filter elements 1.2.

After a pre-set, adjustable time, the ultrasonic generator is switched to lower power and the filter residue elimination valve 1.3 and the compressed air valve 1.12 are closed, whereafter valve 1.9 and valve 1.8 open. Liquid replenishment from the main liquid flow line flows through the restriction 1.10 into filter unit 1. Abrupt disturbances caused by lowered main flow pressure can be eliminated with the restricted flow.

Filling to capacity of the filter chamber is observed by then automatics, which close the valves 1.9 and 1.8 with the aid of the float-operated switch in the float chamber 1.6.

On conclusion of the sequence just described, filter unit 1 remains at stand-by.

When the differential pressure in filter unit 2 rises (due to soiling down) to the pre-set value, the above sequence is repeated, now in this latter unit.

The liquid filtering and homogenizing procedure of the invention is mainly characterized in that the power output of the ultrasonic generator is controlled with a signal from the differential pressure switch or pick-up 1.13 connected across the filter units. This signal may be a limit value-actuated switch-on signal starting the above-described filter cleaning function, or it may be a continuous differential pressure signal from the differential pressure switch 1.13.

Since, as is well known, ultrasonics due to the cavitation which they cause have an attritive effect on materials, its power has to be optimized in relation to the interaction of ultrasonics promoting the filtering and liquid homogenizing action. The efficiency of ultrasonics in aiding liquid filtering and homogenizing is furthermore dependent on a number of factors, e.g the pressure, temperature, viscosity and flow velocity of the liquid, the filter mesh size, and the frequen-

cy/frequency spectrum of the ultrasonics. Therefore the procedure of the invention for filtering and homogenizing liquids is also mainly characterized in that not only the power but also the frequency of the ultrasonics is controlled not only by said differential pressure switch or pick-up 1.13 but also by a liquid pressure pick-up 1.14, a temperature pick-up 1.15 or a liquid flow rate meter or pick-up 1.16 determining the flow going through the filter units.

The procedure of the invention for filtering and homogenizing liquids is further characterized in that endeavours are made to maximize the filter area e.g. as shown in the section A-A in Fig. 1, i.e., by disposing cylindrical filter cartridges in concentric circular configuration in the filter body 1.1, and on the outer circle so that ultrasonic cleaning applied in the filtering process might be needed at intervals as infrequent as possible.

If needed, various ancillaries promoting the action of the invention just described may be added, for instance a heating system to be connected to the jackets of the filter chambers, when implied by the particular liquids to be filtered and by the filtering conditions.

Even otherwise the invention is not confined to the exact configuration presented in the drawing or in the disclosure, and numerous modifications thereof are feasible, within the scope of the claims following below.

CLAIMS

1. A procedure and means for filtering liquid substances with an automatically self-cleaning filter, characterized in that

the means applying said procedure comprises an ultrasonic generator (4) connected in conjunction with a filter unit (1), or units (2), and an ultrasonic oscillator (1.11; 2.11) therewith associated, which upon receiving a signal switches to the power level required in cleaning the filter units (1.2; 2.2) while at the same time a compressed air valve (1.12; 2.12) opens and a pilot valve (1.5; 2.5) opens a draining valve (1,3; 2.3);

the size and degree of throttling of said filter residue removal valve are selected to be suitable in view of the filter chamber emptying time in relation to the cleaning time required by the ultrasonic cleaning process;

after a pre-set, adjustable period of time the ultrasonic power is switched to the power level required in homogenizing the substance that is being filtered, at this time the draining valve (1.3; 2.3) and the compressed air valve (1.12; 2.12) closing, whereafter the valves (1.9 and 1.8) open;

the replenishment fluid derived from a main liquid flow line flows to the filter unit (1; 2) through a restriction (1.10; 2.10);

filling to capacity of the filter chamber (1; 2) is observed by automatics, which close the valves (1.9; 2.9) and 1.8; 2.8) with a float-operated switch in a float chamber (1.6; 2.6).

2. Procedure and means according to claim 1, characterized in that the procedure and means can be simultaneously used, on the side of filtering, to homogenize the substance that is being filtered, by supplying power from the ultrasonic generator (4) also to the ultrasonic oscillators (1.11; 2.11) of the filter unit operating in normal filtering mode.

3. Procedure and means according to claims 1 and 2, characterized in that the power of the ultrasonic oscillators (1.11; 2.11) is controlled on the basis of the differential pressure present across the filter elements (1.2; 2.2).

4. Procedure and means according to claims 1 and 2, characterized in that the power of the ultrasonic oscillators (1.11; 2.11) is controlled on the basis of the flow rate of the substance flowing through the filter.

5. Procedure and means according to any one of claims 1-2, characterized in that the power of the ultrasonic oscillators (1.11; 2.11) is controlled on the basis of the liquid pressure acting in the filter (1.1; 2.1).

6. Procedure and means according to any one of claims 1-2, characterized in that the power of the ultrasonic oscillators is controlled on the basis of the temperature of the liquid flowing through the filter units.

7. Procedure and means according to any one of claims 1-6, characterized in that the power of ultrasonic cleaning is increased by varying the pressure acting in the filter (1.1; 2.1).

8. Procedure and means according to any one of claims 1-7, characterized in that in the filter (1; 2) have been installed at suitable points one or several ultrasonic elements with different frequencies/power.

9. Procedure and means according to any one of claims 1-8, characterized in that cleaning effect of

the filter elements (1.2; 2.2) and homogenizing effect of the liquid flowing through the filter (1; 2) are achieved by suitably varying not only the power but also the frequency and frequency spectrum of the ultrasonic oscillators (1.11; 2.11).

10. Procedure and means according to any one of claims 1-9, characterized in that within the filter body (1.1; 2.1) are installed one or several cylindrical filter elements parallel to the longitudinal axis of the filter body.

AMENDED CLAIMS

[received by the International Bureau on 27 April 1989 (27.04.89) original claims 1-10 replaced by amended claims 1-20 (3 pages)]

1. A pocedure for cleaning a filter automatically when filtering liquid substances and for filtering liquid substances, c h a r a c t e r i z e d in that an ultrasonic oscillator and an ultrasonic generator is switched to the power level required in cleaning the filter unit, a compressed air flushing valve is opened and a draining valve is opened, that said filter residue removal valve is adusted in view of the filter chamber emptying time in relation to the cleaning time required by the ultrasonic cleaning process.

2. Procedure according to claim 1, c h a r a c t e r i z e d in that after a pre-set, adjustable period of time the ultrasonic power is switched to the power level required in homogenizing the substance that is being filtered, and the draining valve (1.3; 2.3) and the compressed air valve are closed, whereafter a flowing valve is opened.

3. Procedure to claim 1 or 2, c h a r a c t e r i z e d in that the ultrasonic oscillator is used to homogenize the substance that is being filtered.

4. Precedure to any one of claims 1 - 3 c h a r a c t e r i z e d in that the filling of the filter chamber is adjusted with a float-operated switch.

5. Procedure according to any one of claims 1 - 4, c h a r a c t e r i z e d in that the power of the ultrasonic oscillator is controlled on the basis of the differential pressure present across the filter elements.

6. Procedure according to any one of claims 1 - 4, c h a r a c t e r i z e d in that the power of the ultrasonic oscillator is conrolled on the basis of the flow rate of the substance flowing through the filter.

7. Procedure according to any on of claims 1 - 4, c h a r a c t e r i z e d in that the power of

the ultrasonic oscillator is controlled on the basis of the liquid pressure acting in the filter.

8. Procedure according ot any one of claims 1 - 4, characterized in that the power of the ultrasonic oscillator is controlled in the basis of the temperatuer of the liquid flowing through the filter.

9. Procedure according to any one of claims 1 - 8, characterized in that the pressure acting in the filter is varied to increase the effect of ultrasonic cleaning.

10. Procedure according to any one of claims 1 - 9 , characterized in that cleaning effect of the filter and/or homogenizing effect of the liquid flowing through the filter are achieved by varying the frequency and/or the frequency spectrum of the ultrasonic oscillator.

11. Means for filtering liquid substances and for cleaning a filter automatically the means conprising a filter unit (1.2; 2.2) and a filter; characterized in that the means comprised in conjunction with the filter unit (1.2; 2.2) an ultrasonic oscillator (1.11; 2.11) and an ultrasonic generator (4), which upon receiving a conrol signal is arranged to be switched to the power level required in cleaning the filter unit (1.2; 2.2); a compressed air flushing valve (1.12; 2.12) which is arranged to be opened; and a draining valve (1.3; 2.3) which is arranged to be opened and adjusted.

12. Means according to claim 11, characterized in that the ultrasonic generator (4) has been arranged to be adjusted to the power level required in homogenizing the substance to be filtered after a pre-set period of time, and the draining valve (1.3; 2.3) and the compressed air flushing valve (1.12; 2.3) are arranged to be closed and the flowing valve (1.9; 1.8) is arranged to be opened.

13. Means according to claim 11 or 12, c h a r a c t e r i z e d in that the ultrasonic generator (4) is arranged to vibrate the ultrasonic oscillator (1.11; 2.11) during filtrating.

14. Meand according to any one of claims 11-13, c h a r a c t e r i z e d in that the means comprises a float-operated switch to adjust the flowing valves.

15. Means according to any one of claims 11-4, c h a r a c t e r i z e d in that the power of the ultrasonic oscillator (1.11; 2.11) is controlled on the basis of the differential pressure present across the filter elements (1.2, 2.2).

16. Means according to any one of claims 11-4, c h a r a c t e r i z e d in that the power of the ultrasonic oscillators (1.11; 2.11) is conrolled on the basis of the flow rate of the substance flowing through the filter.

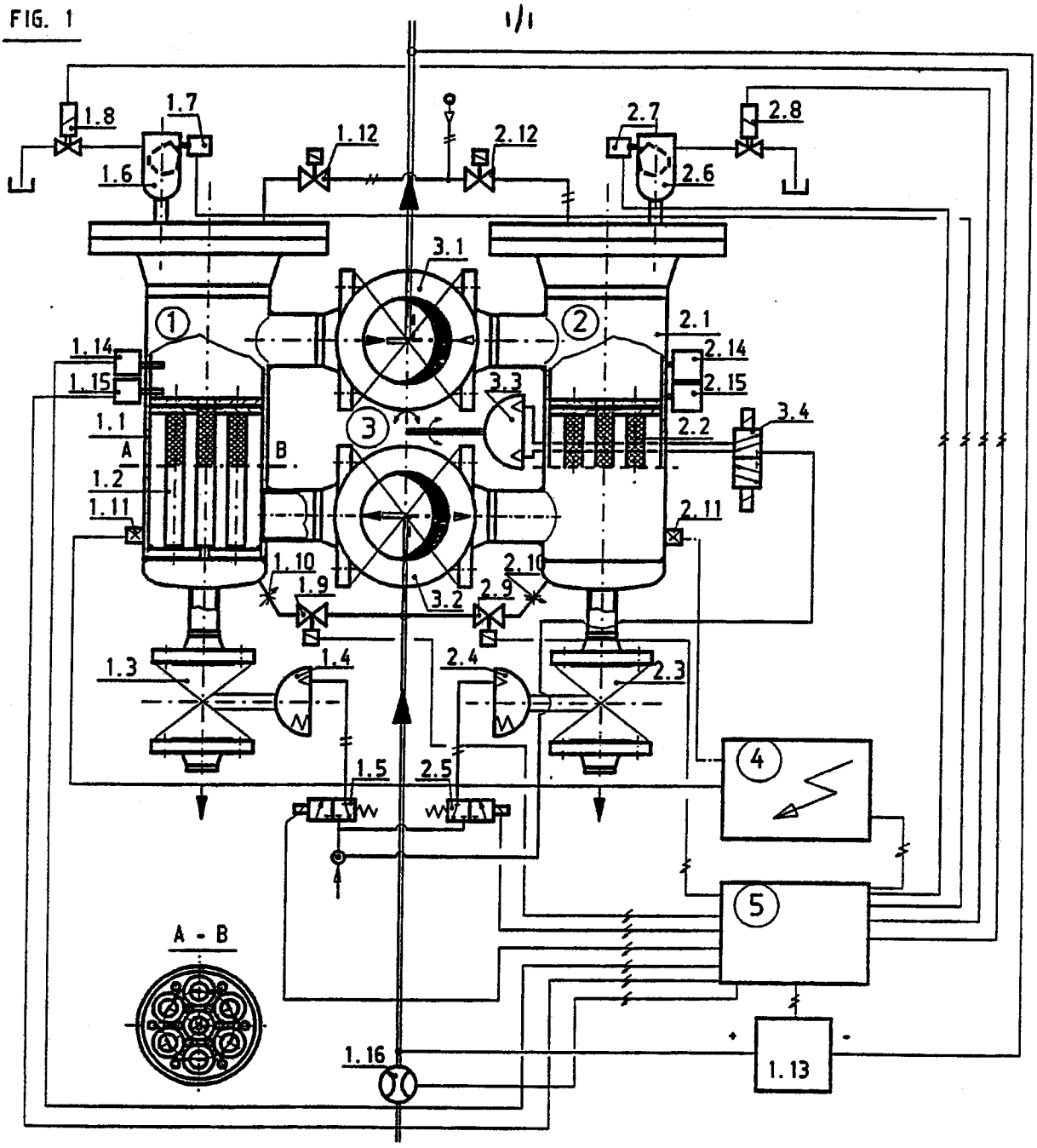
17. Means according to any one of claims 11-14, c h a r a c t e r i z e d in that the power of the ultrasonic oscillators (1.11; 2.11) is controlled on the basis of the liquid pressure acting in the filter (1.1; 2.1).

18. Means according to any one of claims 11-14, c h a r a c t e r i z e d in that the power of the ultraconic oscillators is controlled on the basis of the temperature of the liquid flowing through the filter.

19. Means according to any one of claims 11-18, c h a r a c t e r i z e d in that the means comprises one or several ultrasonic elements with different frequencies/power.

20. Means according to any one of claims 11-19, c h a r a c t e r i z e d in that within the filter body (1.1; 2.1) are installed one or several cylindrical filter elements parallel to the lingitudinal axis of the filter body.

FIG. 1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